Original Article

Norms for anterior–posterior assessment of jaw relationship in Maharashtra population

ABSTRACT

Background: Regularly used parameters for anteroposterior assessment of jaw relationships are ANB angle and Wits appraisal, and recently, beta angle, Yen angle, and W angle are introduced. ANB angle depends on the cranial landmarks and is affected by various factors and often can be misleading. The Wits appraisal does not depend on cranial landmarks, but still has the problem of correctly identifying the functional occlusal plane, which can sometimes be impossible. To overcome these problems, a new measurement, beta angle, was developed at Tufts University. The present study was carried out on Maharashtra population to derive norms of beta angle.

Materials and Methods: For selection of sample, the lateral cephalograms were selected from the available patient's records, and the sample was divided into three groups based on the ANB angle, Wits appraisal, and profile.

Conclusion : The norms of beta angle are between 28.5° and 36.5° in skeletal Class I pattern, <28.5° in skeletal Class II pattern, and >36.5° in skeletal Class III pattern.

Keywords: ANB angle, beta angle, cephalometry, Wits appraisal

INTRODUCTION

Cephalometric techniques are now used routinely not only by orthodontist but also by maxillofacial and plastic surgeons while performing orthognathic surgical and cosmetic procedures. Numerous research and clinical reports on cephalometrics have appeared in the literature as a diagnostic tool for treatment planning, as a communication tool, and as a research tool for studying dentofacial growth and development and for the interpretation of treatment results. Hence, the purpose of basic cephalometric analysis is to characterize or describe the pertinent features of the individual and to establish a classification system through the division of values into specific quantities. Quantification, thus, provides a means of communication of the problems; therefore, analysis can be employed to describe, compare, classify, and communicate the nature of orthodontic and orthopedic problems.

Generally used parameters for anteroposterior assessment of jaw relationships are ANB angle (Riedel, 1952) and Wits appraisal (Jacobson, 1975),[1,2] and recently, beta angle,[3] Yen angle,[4] and W angle[5] are introduced. Several authors give some shortcoming of ANB angle[6-10] and Wits appraisal.[11,12] Because of the limitation and/or drawbacks, a new measurement, beta angle, was developed by Baik and Ververidou at Tufts University.[3] Beta angle is constructed by a line connecting the center of condyle C with point B, line connecting the points A and B, and line from point A perpendicular to the line C-B [Figure 1]. Finally, measuring the angle between the perpendicular line and the A-B line is known as beta angle.

Niyati B. Potode, Twinkle D. Bajaj, Amol A. Verulkar, Swapnil B. Wankhade, Ratndeep A. Lohakpure, Jimmy K. Sangatani

Department of Orthodontics and Dentofacial Orthopedics, V. Y. W. S. Dental College, Amravati, Maharashtra, India

Address for correspondence: Dr. Niyati B. Potode, P. G. Student, Department of Orthodontics and Dentofacial Orthopedics, V. Y. W. S. Dental College 7 Hospital, Wadali, Camp, Amravati, Maharashtra, India.
E-mail: drniyativerulkar@gmail.com

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According to some authors, beta angle is reliable in assessing true anteroposterior apical base discrepancy.[13-15] The purpose of this study is to develop additional cephalometric parameter in assessing true anteroposterior apical base discrepancy for Central Indian population.

MATERIALS AND METHODS

This study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, VYWS Dental College, Amravati, Maharashtrian, India. The sample comprising 260 cephalograms was selected from the available patient's records at the Department of Orthodontics and Dentofacial Orthopedics, VYWS Dental College, Amravati, Maharashtra, and orthodontic clinics in Amravati. The sample was divided into three groups based on the ANB angle, Wits appraisal, and profile.

Inclusion criteria

- Group I – Comprising 100 cephalograms (50 males and 50 females) with Class I skeletal pattern
  - Wherein ANB angle was 1°–3°
  - Wits appraisal was 0–3 mm
  - An pleasant facial profile
  - Permanent dentition with no missing teeth
  - Patients with age group between 15 and 19 years.
- Group II – Comprising 100 cephalograms (48 males and 52 females with Class II skeletal pattern
  - Wherein ANB angle was >4°
  - Wits appraisal was >1 mm
  - Convex or Class II facial profile
  - Permanent dentition with no missing teeth
  - Patients with age group between 15 and 19 years.
- Group III – Comprising 60 cephalograms (32 males and 28 females) with Class III skeletal pattern
  - Wherein ANB angle was ≤1°
  - Wits appraisal was ≤− 4 mm

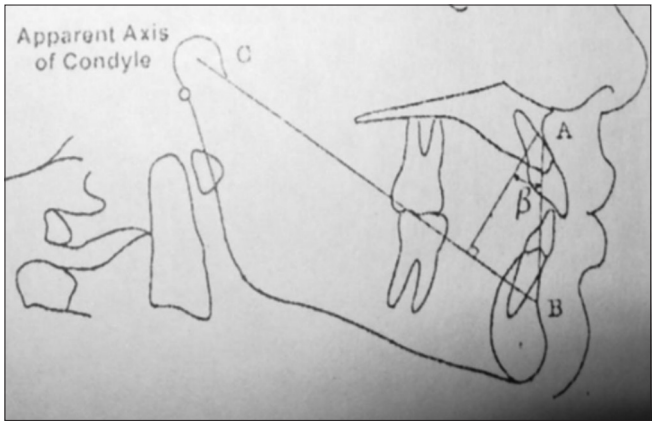

Figure 1: Beta angle

- Concave or Class III facial profile
- Permanent dentition with no missing teeth
- Patients with age group between 15 and 19 years.

Exclusion criteria

- No previous history of orthodontic treatment
- No cranial or facial malformation and no history of craniofacial trauma
- Poor quality of cephalograms.

STATISTICAL ANALYSIS

Data were collected, and to summarize the data, means and standard deviation of beta angle in three groups were calculated. The one-way analysis of variance (ANOVA) was used to determine whether there was a statistically significant difference between the mean values of beta angle of the three groups [Table 1]. $P < 0.05$ was considered statistically significant. After checking a statistically significant difference between the mean values of beta angle of the three groups, we apply ANOVA to check significant difference between the mean values of beta angle between males and females. Receiver operating characteristics curves were run to examine the sensitivity and specificity of beta angle as a test to discriminate between the three different skeletal pattern groups.

The significant difference was observed in three studied groups. The standard limit of the Group I is 31.83–32.57 whereas the standard limit of the Group II is 24.61–25.57 and the standard limit of the Group III is 40.96–42.41 [Table 2] beta angle with standard deviation graphically as shown in Figure 2.

DISCUSSION

In orthodontic diagnosis and treatment planning, the evaluation of the anteroposterior jaw relationship is an indispensable step and this relationship is generally determined using lateral cephalograms, which have been used for many decades now for this purpose. Various angular and linear measurements have been incorporated into the

Table 1: One-way analysis of variance

ANOVA					
Beta_angle					
	Sum of squares	df	Mean square	*F*	Significant
Between groups	10,373.673	2	5186.836	967.937	0.000
Within groups	1377.173	257	5.359		
Total	11,750.846	259			

Conclusion: As $P<0.05$ significant variations are found in all the three types of groups. ANOVA: Analysis of variance

Table 2: Descriptive analysis

	n	Mean	SD	SE	95% CI for mean		Minimum	Maximum
					Lower bound	Upper bound		
1	100	32.20	1.864	0.186	31.83	32.57	28	37
2	100	25.09	2.404	0.240	24.61	25.57	20	38
3	60	41.68	2.795	0.361	40.96	42.41	37	48
Total	260	31.65	6.736	0.418	30.83	32.48	20	48

SD: Standard deviation, SE: Standard error, CI: Confidence interval

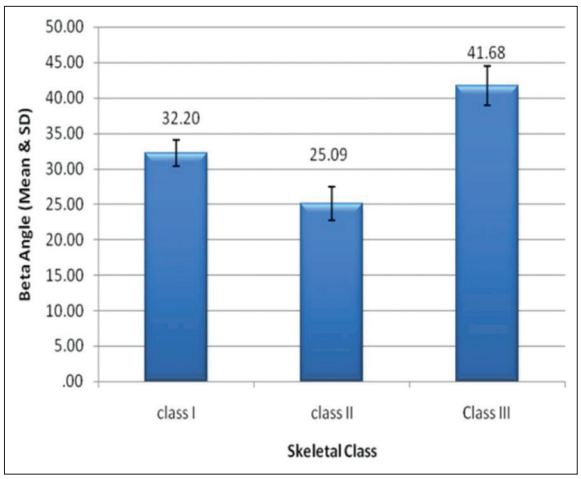

Figure 2: Beta angle with standard deviation graph

cephalometric analysis for diagnosing these anteroposterior discrepancies. The most popular parameter for assessing the sagittal jaw relationship is ANB angle, but it is affected by various factors and often can be misleading. Several authors[6-10] give some shortcoming of ANB angle: the position of nasion is not fixed during growth, and any displacement of nasion will directly affect the ANB angle.[9] Rotation of the jaw by either growth or orthodontic treatment can also alter the ANB reading.[1,8] A popular alternative, the Wits appraisal, does not depend on cranial landmarks, but still has the problem of correctly identifying the functional occlusal plane, which can sometimes be impossible. Accurate identification of occlusal plane is not always easy[11] or reproducible, especially in mixed dentition patients or patients with open bite, multiple impactions, missing teeth, skeletal asymmetries, or deep curve of Spee. Any change in the angulation of the functional occlusion plane, caused either by normal development of dentition or orthodontic intervention, can profoundly influence the Wits appraisal.[12]

To overcome these problems, a new measurement, beta angle, was developed by Baik and Ververidou[3] at Tufts University. The beta angle was found reliable for assessing anteroposterior apical base discrepancy. Aparna *et al.*[13] analyzed that the coefficient of variation values of beta angle is significantly consistent than ANB angle and Wits appraisal, suggesting that the beta angle is reliable. The correlation and regression analysis for the total sample suggests a highly significant relation between beta angle and ANB angle and between beta angle and Wits appraisal. Hence it has been found that beta angle could assess sagittal discrepancies in the population. Sundareswaran and Kumar[14] stated that beta angle is a reliable indicator of sagittal dysplasia in normal and horizontal patterns of growth. Michael *et al.*[15] assessed the reliability of beta angle following activator high-pull headgear therapy.

The sample size in the present study comprised 260 patients, in which 100 patients were Class I, 100 patients were Class II, and 60 patients were Class III, based on the ANB angle, Wits appraisal, and profile. In a similar research conducted by Baik and Ververidou on Greece population with a sample size of 164 pretreatment cephalometric radiographs; that consisted of Class I, II, and III cases, were 76, 42, and 46, respectively. And for Greece population, beta angle was found between 27° and 35° is for skeletal Class I pattern, <27° for skeletal class II and > 35° for skeletal Class III pattern.

The present study was carried out on Maharashtra population, and the results in this study showed beta angle between 28.5° and 36.5° for skeletal Class I pattern, <28.5° for skeletal Class II pattern, and >36.5° for skeletal Class III pattern. There were no significant differences among the gender in Class I, II, and III pattern.

Although beta angle was found to be a reliable method to diagnose skeletal class with equal accuracy with ANB, it is difficult to locate the axis of the condyle due to artifacts in the cephalometric radiograph used. To overcome this drawback, digital radiographs should be used instead of conventional radiographs. Further studies are needed to assess the vertical change in the position of point A and its effect on beta angle. Furthermore, beta angle does not diagnose which jaw is involved in skeletal discrepancy whether maxilla or mandible; therefore, other cephalometric analyses need to be used to assess the position of the jaws.

CONCLUSION

- Beta angle between 28.5° and 36.5° has skeletal Class I pattern; beta angle <28.5° indicates a Class II skeletal

pattern and beta angle >36.5° indicates a Class III skeletal pattern for Central Indian population

- Clinicians should in addition use beta angle as the beta angle enriches the current cephalometric tools available to the clinicians and enables better diagnosis and treatment planning for patients.

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Conflicts of interest

There are no conflicts of interest.

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